examination was made by H. J. Conn, but it led to no result, indicating the weakness of present-day methods. The bacterial numbers fluctuated with the moisture-content, as at other centres. Some interesting soil-moisture relationships are brought to light in Bull. 352 (1914).

E. J. Russell.

THE RAINFALL OF THE UNITED STATES.

PROF. ROBERT DE C. WARD, of Harvard University, contributes an article on "Some Characteristics of the Rainfall of the United States" to the *Scientific Monthly* for September. The article is essentially of a popular character, but it is dealt with in a strictly scientific manner, and references to the several works from which the information is selected are given throughout, so that a closer and more minute study can be made where thought desirable. Many of the characteristics dealt with are among the most important, and certainly the most interesting, associated with rainfall. There is an endeavour to explain the cause of the special characteristics, a feature in many discussions of the present day. It has often been said in the past, with respect to meteorology, that there are bricks enough, but that we now require builders. Those who have been familiar with meteorology for the last half-century note with satisfaction its practical development.

Referring to the annual and monthly rainfall, Prof. Ward associates the varying amounts with the tracks of cyclones and the general pressure distribution which constitute the rain-producing conditions. The ratio of wettest and driest years to the mean fall is given for the United States generally. Where the annual rainfall ranges from 5 in. to 30 in. the fall in the wettest years may be expected to amount to about 180 per cent. of the average, whilst in the driest years the total is not likely to be less than about 55 per cent. of the average. Years with precipitation above the mean are less frequent than years with precipitation below the mean. It is emphasised that it is always instructive to investigate the weather-map conditions in all cases of unusually wet or dry periods, and to follow especially the tracks of low-pressure systems.

Dealing with periods with or without precipitation, the article states that "over most of the country the number of consecutive rainy days has been between 10 and 20. . . . On the north-western coast (Western Oregon), where the rainfall is heavy and the cyclonic activity is marked, more than 30 days in succession (30 to 40) have been rainy. . . ."

It is said that droughts may occur anywhere in the United States, especially where cyclonic controls of precipitation are weak. There is a distinct relation between droughts and forest fires—"a pre-requisite of a forest fire is a drought."

The Government meteorological reports, such as the Annual Report of the Chief of the Weather Bureau and the Monthly Weather Review, give much valuable material with respect to rainfall. As a rough-and-ready classification of excessive rainfalls, mention is made of 10 in. or more in a month; 2·50 in. or more in twenty-four hours; and 1 in. or more in an hour. Referring to secular variation of rainfall, it is pointed out that trustworthy conclusions cannot be drawn, as few observations go back to 1850, and most observations date from later than 1870. A period of observations for twenty-five years, 1887–1911, for all districts of the United States "lends no colour to the theory of a cycle in precipitation," and curves for New England, the Western Gulf, and North Carolina for 1879–1911 "show no approach to uniformity of distribution in time or space." For non-instrumental evidence a study has been made of the "rings" of trees in Arizona and California, "it being assumed that the thickness of the annual layers of tree-growth gives an approximate measure of the annual amount of precipitation. . . . The fact that the 'big trees' have continued to thrive for three thousand years has been taken to indicate a remarkable uniformity of climatic conditions rather than a series of oscillations."

C. H.

RETIREMENT OF SIR OLIVER LODGE.

ON January 1 the City of Birmingham gave expression to its high appreciation of the work of Sir Oliver Lodge as Principal of the University. At a meeting in the Council House, at which the Lord Mayor (Alderman William Cadbury) presided over a representative gathering of the leading citizens, an illuminated address was presented to Sir Oliver and Lady Lodge. The address, which was read by Sir Gilbert Barling (Vice-Chancellor of the University), was as follows:—"To Sir Oliver Lodge, F.R.S., LL.D., and Lady Lodge: On the eve of your departure from Birmingham we desire to express to you our deep sense of loss, our sincere appreciation of your great services, and our warmest wishes for your happiness and well-being in your new home. To you, Sir Oliver, we owe much as a physicist. Your distinction has added lustre to our city. As academic leader you have started our University on its career with lofty ideals. You have done much to form public opinion as to the meaning of true education in all its forms and among all classes, and your ethical teaching has ever been directed towards social amelioration. You may be satisfied that your labours of nearly twenty years have left a deep and lasting mark on the community which you have so long adorned. To both of you we wish good-bye with the deepest regret, and our most kindly feelings accompany you."

Sir Gilbert added that it was the intention of the subscribers to present also more substantial evidence of their kind feelings in the form of a motor-car, and a jewel for Lady Lodge. He reminded his audience of the greatness of the task which Mr. Joseph Chamberlain had set before the first Principal of the University, and he bore eloquent testimony to the admirable way in which Sir Oliver had realised the ideals of that statesman and justified his choice.

Sir Oliver Lodge in his reply emphasised the debt which the city owed to those public-spirited men who had gone before. He hoped the city had become proud of the University which it had brought into being. It took a little time always to know what an institution was worth, but the University was the crown of the city. He referred to the difficulties under which the University had laboured through lack of funds, but he believed that a better day was dawning. The State and the city were co-operating to a greater extent than before. One of the first uses he proposed to make of his freedom was to visit America. He had often been asked to go, but had never before been free to do so.

THE CHIPPAWA-QUEENSTON HYDRO-ELECTRIC DEVELOPMENT SCHEME.

AMONG the whole of the world's sources of water-power the Niagara Falls stand in a position of unique importance. Not only is the gross capacity of 5,000,000 h.p a magnificent industrial asset of unrivalled proportions, but the actual development of the Falls at the present time has enabled

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the Hydro-Electric Power Commission of Ontario to create the largest system of electric transmission in the world. There are altogether ten plants belonging to the commission in various parts of the province, aggregating 248,000 h.p., and supplying nearly 200 municipalities, to which Niagara contributes the supply for 118. The transmission lines comprise 455 miles of 110,000 voltage, double circuit, and 2100 miles of low tension. Such has been the achievement of the commission up to the end of last year.

There is now in hand a most important extension of this remarkable system. The Chippawa-Queenston project, as it is designated, will within a few years' time increase the serviceable capacity by from 200,000 h.p. to 300,000 h.p., and, ultimately, by 1,000,000 h.p. The first instalment of the work is expected to be ready by the spring of 1921, at an estimated cost of 5,000,000*l*. We gather the following interesting particulars of the project from a recent series of articles in the *Engineer* :—

Instead of the relatively small head (between 135 ft. and 165 ft.) of the actual Falls, it is proposed to utilise nearly the full difference in level, amounting to 330 ft., between the surfaces of Lakes Erie and Ontario. In order to effect this, a canal nine miles in length will be excavated so as to connect the Welland River with the Niagara River at Queenston, and the Welland River itself will be widened and deepened for $4\frac{1}{2}$ miles from its mouth. The channel thus formed will deliver water to a power-house below the Falls under a head of 305 ft., which will enable 30 h.p. to be developed for each cusec of flow instead of the 14 h.p. per cusec which is all that is available from the existing installation. The mean velocity of flow will be 2 ft. per sec. in the Welland River and 6 ft. to 7 ft. per sec. in the canal, resulting in a discharge of 10,000 cusecs at low-water level.

The canal route lies mainly in the solid rock of the Niagara Limestone formation, with the remainder ($1\frac{1}{2}$ miles) in earth and loose material. In rock the cross-section will be rectangular, 48 ft. in width; in earth it will be prismatic, with a bottom width of 70 ft. and side-slopes of 1 in $1\frac{5}{8}$, pitched with stone facing.

At the delivery end of the canal a forebay will be formed in solid rock 1000 ft. long, widening to 300 ft. at the extremity. Penstocks of riveted steel plates, 14 ft. in diameter and about 450 ft. in length, will extend down to the power-house at the foot of the river-bank.

The initial generating plant will consist of 4 to 6 units of 50,000 h.p. each. On each turbine-shaft there will be a 3-phase, 25-cycle, 12,000-volt internal revolving field generator of 43,900 kilovolt-amperes at a power factor of 85 per cent.

BRYSSON CUNNINGHAM.

THE ORGANISATION OF CHEMICAL INDUSTRIES.

AT the meeting of the London Section of the Society of Chemical Industry, held at Burlington House on Monday, January 5, two interesting papers were read by Mr. E. V. Evans and Dr. G. S. Walpole on the present position of the chemical industry of Germany. The authors of these papers were deputed to visit a number of important chemical factories in the Rhine Valley in the early part of last year. They are well-known chemists with considerable experience of chemical plant on a large scale. The information which they were able to disclose was valuable and suggestive. Mr. Evans and Dr. Walpole described the German chemical factories as being maintained in a state of perfection, but paralysed at the moment through lack of labour and raw materials. They contrasted the huge and well-staffed factories in Germany with the smaller equipments in this country, and dealt in particular with the manufacture of dyestuffs and intermediate products which has been developed in this country since the outbreak of war.

During the war the demand of the country for raw materials for war purposes was so great as to make it impossible to organise this new industry on a scale adequate to compete with the German chemical industry. The authors of the papers were satisfied that the ability and knowledge of British chemists were at least equal to those of their German competitors, but they directed attention to the fact that it was not possible in the long run for a number of firms in this country, each producing a limited number of products in comparatively small quantities, to compete successfully with the huge German factories, all amalgamated into one organisation and capable of turning out in a relatively small number of places the huge quantities of dyes required by the world.

To enable this country to retain the trade in dyestuffs and intermediates which were now being manufactured here, and to enable it to do a certain amount of export trade in these commodities, there must be an organisation comparable with that of Germany, and time would be required to build up such an organisation. Meanwhile, some protection against the importation of German dyestuffs and intermediate products was necessary, and the trade could not flourish until some of the existing Government restrictions were removed.

The action of the Government in licensing the importations of German dyestuffs was a useful measure and had been of great value. It is to be hoped that these important papers will stimulate the chemical trade of this country and the Government Departments concerned to study the better organisation of chemical industries here and to put forward some carefully considered scheme.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE break in the continuity of sectional proceedings due to war conditions had, to a great extent, prevented those interested in geology throughout the country from keeping in touch with one another, and full advantage was taken of the opportunity for reunion offered by the Bournemouth meeting. Although arranged at short notice, the standard of former years was well maintained in the communications presented, and every moment of the week was full of interest.

The district has long been famous for its geological features, and consequently much interest has been taken locally in this branch of science. As a result, the papers by Dr. W. T. Ord on the Tertiary rocks of the Hampshire basin and the erosion of Bournemouth Bay, coupled with Mr. H. Bury's contribution on the history of the Chines, gave rise to considerable discussion. Important records of the rate of marine erosion at the present time and in recent years were contributed by many of those taking part in the discussion, and the Borough Engineer's measurements taken a short time ago were confirmed by collateral evidence.

Mr. Reginald Smith's paper on the Post-Tertiary geology of the area round Bournemouth, with special reference to the worked flints collected from many of the beds, was introductory to a joint discussion with Section H, and produced a very animated controversy. An admirable exhibit of such flint implements was arranged specially for this meeting by Mr. Scott, and added point to many of the remarks.

A second joint meeting, namely, with Section D

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